

1. A method for making a metal-insulator-metal capacitor on a substrate comprising the steps of:

forming bottom electrodes from a first conducting layer on said substrate;

5 depositing a first wide-band-gap insulating layer on said bottom electrodes;

depositing a high-k dielectric film over said wide-band-gap insulating layer;

10 depositing a second wide-band-gap insulating layer over said high-k dielectric film;

forming top electrodes from a second conducting layer on said second wide-band-gap insulating layer.

2. The method of claim 1, wherein said bottom  
15 electrodes and said top electrodes are formed from a material selected from the group that includes titanium nitride, tantalum nitride, tungsten nitride, ruthenium, iridium, iridium oxide, and platinum, and is deposited to a thickness of between about 200 and 1000 Angstroms.

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3. The method of claim 1, wherein said first and said second wide-band-gap insulating layers are materials selected from the group that includes silicon dioxide and aluminum oxide.

4. The method of claim 1, wherein said high-k dielectric film is a material selected from the group that includes tantalum pentoxide, silicon nitride, titanium oxide, zirconium oxide, and hafnium oxide.

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5. The method of claim 4, wherein said high-k dielectric film is deposited by physical vapor deposition.

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6. The method of claim 4, wherein said high-k dielectric film is deposited by chemical vapor deposition.

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7. The method of claim 4, wherein said high-k dielectric film is deposited by atomic layer chemical vapor deposition.

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8. The method of claim 4, wherein said high-k dielectric film is deposited to a thickness of between about 50 and 800 Angstroms.

9. The method of claim 4, wherein said high-k dielectric film is treated in a gas selected from the group that includes oxygen, nitrogen, nitrous oxide,

and ammonia, and rapid thermally annealed at a temperature of between about 300 and 700°C for a time of between about 1 and 260 seconds.

- 5     10. A method for making a metal-insulator-metal capacitor on a substrate comprising the steps of:
- forming bottom electrodes composed of titanium nitride on said substrate;
- depositing a first wide-band-gap insulating layer
- 10    composed of aluminum oxide over said bottom electrodes;
- depositing a high-k dielectric film composed of tantalum pentoxide over said wide-band-gap insulating layer;
- depositing a second wide-band-gap insulating layer
- 15    composed of aluminum oxide over said high-k dielectric film;
- forming top electrodes composed of titanium nitride over said second wide-band-gap insulating layer.
- 20    11. The method of claim 10, wherein said bottom electrodes and said top electrodes composed of titanium nitride have a thickness of between about 200 and 1000 Angstroms.
- 25    12. The method of claim 10, wherein said first and said second wide-band-gap insulating layers composed of

aluminum oxide have a thickness of between about 10 and 50 Angstroms.

13. The method of claim 10, wherein said high-k  
5 dielectric film composed of tantalum pentoxide has a thickness of between about 50 and 800 Angstroms.

14. The method of claim 10, wherein said tantalum pentoxide is deposited by chemical vapor deposition.

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15. The method of claim 10, wherein said tantalum pentoxide is treated in a gas selected from the group that includes oxygen, nitrogen, nitrous oxide, and ammonia, and is rapid thermally annealed at a  
15 temperature of between about 300 and 700°C for a time of between 1 and 260 seconds.

16. A method for making a metal-insulator-metal capacitor on a substrate comprising the steps of:

20 forming bottom electrodes on said substrate;  
depositing a first wide-band-gap insulating layer over said bottom electrodes;  
depositing a multilayer of high-k dielectric films over said wide-band-gap insulating layer;  
25 depositing a second wide-band-gap insulating layer over said multilayer;

forming top electrodes over said second wide-band-gap insulating layer.

17. The method of claim 16, wherein said bottom  
5 electrodes and said top electrodes are formed from a material selected from the group that includes titanium nitride, tantalum nitride, tungsten nitride, ruthenium, iridium, iridium oxide, and platinum.
- 10 18. The method of claim 17, wherein said material is deposited to a thickness of between about 200 and 1000 Angstroms.
- 15 19. The method of claim 17, wherein said multilayer of high-k dielectric films is composed of materials selected from the group that includes tantalum pentoxide, silicon nitride, titanium oxide, zirconium oxide and hafnium oxide.
- 20 20. The method of claim 17, wherein each layer of said multilayer of high-k dielectric films is treated in a gas selected from the group that includes oxygen, nitrogen, nitrous oxide, and ammonia, and rapid thermally annealed at a temperature of between about  
25 300 and 700°C for a time of between about 1 and 260 seconds.